ESTABLISHMENT OF CO-RELATION FACTOR FOR STRAIN HARDENING RATIO AND CARBON EQUIVALENT OF MOSTLY USED 16MM DIAMETER LOCALLY MANUFACTURED REBARS

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree

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DECLARATION

I confirm that this thesis is entirely my own work and does not include, without proper acknowledgment, any material previously submitted for a degree or diploma at any other university or institution of higher education. To the best of my knowledge, it does not contain any material previously published or written by another person, except where due acknowledgment has been made within the text.

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I hereby certify that the above-named candidate has carried out the research work presented in this Master's thesis under my supervision. I further confirm that the declaration made by the candidate is accurate and true to the best of my knowledge.

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ABSTRACT

The construction industry in Sri Lanka relies extensively on locally manufactured 16mm diameter rebars for structural applications. Ensuring the mechanical reliability of these rebars is essential for safe and durable construction. This thesis, titled *"Establishment of Predictive Models for Strain Hardening Ratio Based on Carbon Equivalent in Locally Manufactured 16mm Rebars,"* investigates the relationship between the Tensile-to-Yield strength ratio (T/Y) and Carbon Equivalent (CE), a key metric derived from chemical composition.

The research began by tracing the historical evolution of CE as a predictor of mechanical behavior, highlighting its established role in estimating ductility and strain-hardening characteristics. Using tensile test data and CE values calculated via BS 4449:2015, a linear regression analysis confirms a statistically significant relationship between CE and T/Y, consistent with prior metallurgical findings. This validation reinforces CE as a reliable indicator of mechanical performance in rebars.

Building on this foundation, the study introduces a binomial logistic regression model that classifies rebar compliance based solely on CE. By defining a ductility threshold ($T/Y \geq 1.15$), the model enables binary classification of rebar quality, offering a practical, non-destructive method for compliance screening. The model demonstrates high classification accuracy and strong ROC performance, making it suitable for integration into QA/QC workflows.

The outcomes of this research provide the construction sector with a dual-layered analytical framework: one that confirms the CE–T/Y relationship through regression, and another that operationalizes CE as a predictive tool for quality assurance. This approach enhances traceability, efficiency, and decision-making in material selection. Future research is recommended to explore the influence of manufacturing processes, environmental exposure, and broader diameter ranges on model robustness.

Keywords: Carbon Equivalent, Tensile-to-Yield Ratio, Linear Regression, Binomial Logistic Regression, Rebar Compliance, 16mm Diameter, QA/QC, Sri Lankan Construction

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LIST OF ABBREVIATIONS

Abbreviation	Description
CE	Carbon Equivalent
T/Y	Tensile Stress / Yield Stress
UTS	Ultimate Tensile Strength
YS	Yield Strength
QA/QC	Quality Assurance / Quality Control
UTM	Universal Testing Machine
XRF	X-ray Fluorescence (XRF) spectrometer
OES	Optical Emission Spectrometer
ANOVA	Analysis of Variance
ROC	Receiver Operating Characteristic
AUC	Area Under Curve
BS	British Standard
AWS	American Welding Society
IIW	International Institute of Welding